

COMPARATIVE NOTES ON RHOPALOCERA COMMON TO INDIA AND EAST AFRICA¹

D. G. SEVASTOPULO²

The following notes on Rhopalocera, common to India and East Africa, may prove of interest. I have treated the term 'India' in its geographical context, not the political, and readers are expected to have a rough general knowledge of the two areas.

It was at one time intended to include my original descriptions and photographs of the larvae of most of the undermentioned species, as well as many others, in Bernard D'Abbrera's recently published book BUTTERFLIES OF THE AFROTROPICAL REGION, but unfortunately pressure of time and space prevented this. These descriptions and photographs have now been presented to the British Museum (Natural History).

PAPILIONIDAE

There is no species of Papilionidae common to the two areas, although previously some authors treated *Papilio demodocus* Esp. as a subspecies of *P. demoleus* L. Both species are very much alike in all stages and both are unusual in having three colour forms of pupa—a green and a pink, which are constant in tint, and a brown that varies from dark to pale. The green form of pupa of *P. demodocus* has a diffused, pale mauve, dorsal and lateral stripe, which is lacking in *demoleus*.

P. demodocus occurs all over Africa south of the Sahara, and has one subspecies, *bennetti*

Dixey, on the Island of Socotra, whilst nominotypical *demoleus* occurs over the whole of India to Northern Burma, Sri Lanka, Iran and Arabia; ssp. *malayanus* Wallace occurs in Southern Burma, Thailand and the Malay Peninsula. Other subspecies occur in China, the smaller Sunda Islands and South New Guinea, in Australia ssp. *sthenelus* Macl. occurs. The species is absent from the Philippines, the large Sunda Islands, the Celebes and the Moluccas.

Both species feed on *Citrus* and other Rutaceae, but *demodocus* is also recorded from *Pseudospondias* (Anacardiaceae), *Ptaeroxylon* (Meliaceae), *Hippobromus* (Sapindaceae) and *Bubon* and *Gummifera* (Umbelliferae). The Australian *demoleus sthenelus* feeds mainly on *Psoralea tenax* (Papilionaceae), rarely on *Citrus*, and the mature larva is said to be spotted with orange. Larvae reared in South Africa on an Umbellifer, possibly *Daucus*, are said to have had a peculiar chequered pattern.

I have described the early stages of *demoleus* in the *Bombay Natural History Society Journal*, 41: 311 (1939), 45: 198 (1945) and 46: 576 (1947) and have presented typescript descriptions and photographs of the early stages of *demodocus* to the British Museum (Natural History).

PIERIDAE

Anapheis aurota F.

The nomino-typical form occurs in both areas, the more usual form in East Africa be-

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² P. O. Box 95617, Mombasa (Nyalii), Kenya.

ing the dry season f. *lordaca* Wlk., with a white underside and narrow well-defined black markings, I have never seen a specimen with the deep chrome yellow underside in East Africa. Ssp. *aurota* also occurs as a straggler in the Nicobar Islands and in Asia Minor. The species does not occur in Assam and Burma. In Sri Lanka it is represented by ssp. *taprobana* Moore, which has more black on the upper side of the forewing and the underside deep chrome yellow. It is a confirmed migrant, sometimes moving in vast swarms.

The description and figure of the early stages (Talbot, FAUNA BRIT. INDIA, *Butterflies*, i, 2nd edit.) applies to both areas. I once found pupae in countless thousands at Mackinnon Road, a scrubby area about fifty miles up the Mombasa/Nairobi road, obviously the progeny of a migrant swarm. All the available Capparidaceae had been stripped of leaves and the pupae were clustered thickly on all suitable twigs, they were side by side and nose to tail and even, in some cases, a second layer formed on top of the first. These pupae were sooty black blotched with white, although the few, still unupated larvae were normal in appearance. A similar assemblage of pupae found at Qatar (Saudi Arabia) were said to be normal in appearance.

Food-plant: Various species of Capparidaceae. Talbot (loc. cit.) states that the larvae are much subject to parasites, but I have not found this.

I have described the early stages in India in the *JBNHS* 47: 459 (1948) and have presented typescript descriptions and photographs of East African examples to the British Museum (Natural History).

Colotis calais Cr.

Varshney, in a paper entitled "Revised Nomenclature for Taxa in Wynter-Blyth's Book

on the Butterflies of Indian Region" (1980, *JBNHS* 76(1): 33-40) considers that the Fabrician name *amata* has priority over Cramer's *calais*, but most authors, including D'Abrera, do not share his views. Peile (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA, 1937) uses *amata*.

The nomino-typical form is found in Africa south of the Sahara but not in the forested areas of West Africa and Zaire, nor in very high areas. It is very common in the Coast Province of Kenya. A separate subspecies, *crowleyi* Sharpe occurs in Madagascar.

Two subspecies occur in India, *modestus* Btlr. in Peninsular India and Bengal and *amatus* F. elsewhere. It is also found in Syria and Iran, Peile (loc. cit.) considers it less common than *protractus* Btlr. and *vestalis* Btlr., but in Kenya it is far the commonest of the *Salvadora*-feeding species.

Talbot (loc. cit.) describes the early stages of *modestus* and figures the pupa (fig. 157). I have not bred it in India, but have presented typescript descriptions and photographs of the East African early stages to the British Museum (Natural History). The larvae are gregarious and feed on *Salvadora* and *Azima* (*Salvadora*-ceae).

Colotis phisadia Godt.

Ssp. *protractus* Btlr. is found in the drier parts of India, namely Baluchistan, N. W. Frontier, Cutch, Punjab, Sind and Karwar. D'Abrera enumerates no fewer than five subspecies from Africa, two from East Africa, i.e. *vagus* Riley from northern Uganda and northern Kenya, and *rothschildi* Sharpe from southern Uganda and southern and coastal Kenya. Outside our limits the nomino-typical form *phisadia* Godt. occurs in the Somali Republic, Eritrea, northern Ethiopia and Sudan to Chad, Senegal and Mauritania (as well as in Arabia), ssp. *ocella-*

tus Btlr. in Ethiopia and ssp. *somalica* Storaž in the Somali Republic. Outside Africa the species occurs from Iran to Palestine.

Talbot (loc. cit.) describes the early stages of *protractus*. I did not breed the species in India but have presented typescript descriptions and photographs of the early stages of *rothschildi* to the British Museum (Natural History). Another *Salvadora*-feeder, but the larva is solitary.

Colotis vestalis Btlr.

The nomino-typical subspecies is found from Sind to Baluchistan, Punjab and Western India, and extends outside our area to the Persian Gulf. The East African subspecies is *castalis* Staud. and occurs in Kenya and Tanzania, outside East Africa it extends to Somalia, southern Ethiopia and the Sudan. I have found it uncommon in Kenya.

Talbot (loc. cit.) describes the early stages but I have not bred it in either India or East Africa. The larva feeds on *Salvadora*.

Colotis danae F.

Two subspecies occur in India, nomino-typical *danae* in Peninsular India and Sri Lanka and ssp. *dulcis* Btlr. in Kathiawar, Sind and Baluchistan. Altogether there are four subspecies in Africa, two in East Africa, ssp. *pseudacaste* Btlr. from Tanzania, Kenya, Uganda and north-eastern Zaire and ssp. *eupompe* Klug from northern Uganda and northern Kenya as well as from Mauritania and Senegal, along the southern fringe of the Sahara to northern Nigeria, Sudan, Ethiopia, the Somali Republic as well as Arabia; outside East Africa ssp. *walkeri* Btlr. occurs in Angola and Namibia and *annae* Wlgrn. in South Africa, Zimbabwe, Mozambique, Botswana, Zambia, Malawi and the Shaba Province of southern Zaire. The species also flies in Iran.

There is considerable seasonal variation and a number of forms, mainly in India, have received names. Generally speaking, the wet season forms have heavier black markings on the upperside and a series of post-discal spots on the hindwing underside. Some extreme dry season forms have the underside tinged with red or pink.

Talbot (loc. cit.) describes the early stages, but the larva and pupa figured on Plate II, figs. 11 & 12 is NOT, repeat NOT, this species but *C. eucharis* F. I did not breed the species in India, but have presented descriptions and photographs of the early stages of ssp. *pseudacaste* to the British Museum (Natural History).

Colotis eucharis F.

The nomino-typical subspecies occurs in India and is found from Central India to Sri Lanka. The East African subspecies is *evarne* Klug and differs little from the Indian, it is found from Senegal to Upper Volta, northern Nigeria, Sudan, Ethiopia, Uganda, Kenya and the Somali Republic. It also occurs in Arabia.

The position was previously complicated by the fact that various forms with a primrose yellow ground colour were considered to be subspecies of *eucharis*, they are now considered to be subspecies of *C. auxo* Lucas, itself previously considered a subspecies of *eucharis*. Personally I have no doubt that this is the correct assessment. Although broadly sympatric, I have never found white and yellow populations occupying the same micro-habitat, I have never seen a yellow female lacking the orange apex of the fore-wing, and, although I have bred many broods from both white and yellow females, I have never had a mixed brood, families have invariably been either all white or all yellow. Both have the same food-plants. However D'Abrera treats *auxo* Lucas from eastern Cape Province to Natal and Transvaal and

southern Mozambique as a subspecies of *eucharis*. Outside East Africa ssp. *dissociatus* Btlr., a white form, occurs in Malawi, Zambia, Zimbabwe, Botswana, Northern Mozambique and Tanzania.

The female sometimes occurs lacking the orange apex to the forewing and I have shown that this form is recessive to that with the orange apex (Sevastopulo, 1962, *Entomologist*, 95: 4).

Talbot (loc. cit.) describes the early stages of *eucharis* and stresses the unusual shape of the pupa, but, in spite of this, captions the figures on Plate II, figs. 11 and 12 as *danae* instead of this species. I did not breed this species in India, but I have presented typescript descriptions and photographs of the early stages of *evarne* to the British Museum (Natural History).

Food-plant: *Cadaba* spp. and other species of Capparidaceae.

***Colias electo* L.**

The subspecies found in India is *feldi* Men., which occurs from Baluchistan to the northern Punjab and Sikkim; it is more common in the western Himalayas and it also extends to north Burma. It varies considerably in size but no white form of female is known from India. The East African subspecies is *pseudohecate* Berger, which occurs in Kenya, Tanzania and Uganda, and also in Malawi, eastern Zaire, Rwanda, Burundi, southern Sudan, southern Ethiopia and northern Somali Republic. It has a white female form f. *aurivilliusi* Kef. The nomino-typical subspecies occurs in South Africa, southern Mozambique, Namibia, Zimbabwe and Zambia south of Kabwe. Other African subspecies are *hecate* Strecker from Angola, southern Zaire, northern Zambia and north-western Malawi, and *meneliki* Berger from central and northern Ethiopia and Eri-

tree. Outside our limits it is found from Europe to West China, Arabia, Tibet, the Canary Islands and Madiera.

Talbot does not describe the early stages and I have not bred it in either India or East Africa.

Food-plant: Lucerne and other Leguminosae.

***Eurema hecabe* L.**

Five subspecies have been recognised from the Indian subcontinent, *contubernalis* Moore from Bengal to Sikkim, Burma and the Malay Peninsular, *simulata* Moore from Peninsular India, Madhya Pradesh and Sri Lanka, *fimbriata* Wall. from the Punjab to Chitral and Kumaon, *blairiana* Moore from the Andamans and *nicobariensis* Feld. from the Nicobar Islands. The various forms tend to grade into each other, even the island forms. There is a white female form *lacteola* Dist. D'Abrera has recently treated *senegalensis* Bsd. and *floricola* Bsd. as good species, previously considered subspecies of *hecabe*, the former from western Uganda to Congo Republic, Cameroun, Nigeria, Liberia, Sierra Leone and Senegal and the latter from Madagascar, Aldabra Island, Comore Islands, Mauritius and Reunion; he uses the name *solifera* Btlr., from Savannah and woodlands in all the Afrotropical region except the extreme south-west of Cape Province for the sole *hecabe* subspecies in Africa. Outside our limits the species extends over the whole Indo-Australian Region northwards to Korea and Japan and the whole Ethiopian Region.

Talbot (loc. cit.) describes, but does not figure, the early stages and I have described them in this *Journal*, 44: 80(1943). I have also presented typescript descriptions and photographs of the East African early stages to the British Museum (Natural History).

Food-plant: Leguminosae of all three sections.

Eurema brigitta Cr.

Almost as wide-spread as the previous species, covering the whole Ethiopian and Indo-Australian regions and extending to Taiwan and southern China, but far less variable. The single Indian subspecies is *rubella* Wall. The African subspecies is nomino-typical *brigitta*, the dry season form *zeo* Hpffr. has the under-surface sulphur yellow and the fringes are never pink.

Talbot (loc. cit.) describes, but does not figure, the early stages. I have not bred the species in either India or East Africa.

Food-plant: In India it is said to feed on *Cassia kleinii* (Caesalpinaceae) and probably other Leguminosae. In Africa it is said to feed on *Hypericum* (Hypericaceae).

Catopsilia florella F.

The Indian subspecies is *gnoma* F. but very recently Varshney (loc. cit.) has stated that the correct name for the Indian population is *pyranthe* L. and *florella* is merely the dry season form. Talbot (loc. cit.), whilst treating *pyranthe* and *florella* as two separate species, also suggests that they may be conspecific with *pyranthe* the wet and *florella* the dry form. An extreme dry season form has been named f. *thisorella* Bsd. Ssp. *gnoma* occurs commonly in India, Burma and Sri Lanka and rarely in the Andaman Islands. Nomino-typical *florella* F. occurs all over the Afrotropical Region, unfortunately the yellow female is considered to be the typical form, so that the commoner, male-like female is known as *pyrene* Swains., other female forms are f. *hyblaea* Bsd. with paler, whitish-yellow wings above and f. *aleurona* Btlr. with the wings whitish basally and the distal margin yellow. It now remains to be decided whether the Indian and African populations are conspecific, in which case *florella* falls to *pyranthe* as a synonym.

D'Abbrera, whose book is the latest on African butterflies, uses *florella*. Outside India and Africa, the *pyranthe/florella* complex extends over Arabia, Iran, Indo-China, Hainan, Taiwan, Borneo, Java, the Celebes and Philippines and Australia. It also occurs in the Canary Islands.

Several incomplete breeding experiments appear to indicate that the nomino-typical yellow female form is dominant to the male-like *pyrene*. (Sevastopulo, 1970, *Entomologist*, 103: 70).

Talbot (loc. cit.) describes the early stages and states that the larvae feed gregariously. I have not noticed this in East Africa, and the ova are laid singly, not in batches. Possibly this is another indication that the two populations are not conspecific. I did not breed the species in India but have presented typescript descriptions and photographs of the East African early stages to the British Museum (Natural History)

If reared indoors in poor light the larvae develop a black lateral stripe, often joined across the dorsum by black bars on the thoracic and posterior somites. If they are fed on *Cassia* flowers, either yellow or pink, instead of leaves, they are a dull yellow colour but the resulting pupae do not differ from the normal, indicating that the pupal pigment is not a chlorophyll derivative.

Food-plant: *Cassia* spp. and other Caesalpinaceae.

Pontia glauconome Klug

The species occurs from Baluchistan to the Punjab and Chitral. It is rare. The dry season form has been named *iranica* Biernert. It also extends to Turkestan, Iran, Syria, Arabia and the Island of Socotra. In Africa it occurs in the Somali Republic, Kenya, Ethiopia, Sudan, Chad and probably northern Nigeria. In spite of being normally found in arid areas, I have

taken two specimens in the Shimba Hills. Ssp. *distorta* Btlr., described as inhabiting very dry areas in Ethiopia, Somali Republic, Kenya and north-eastern Tanzania, has now been separated as a good species. Nothing appears to have been published about the early stages.

DANAIDAE

Danaus chrysippus L.

There is very little difference between the nomino-typical subspecies found in India and ssp. *aegyptius* Schreber found all over the African continent, the latter being slightly darker and with a narrower pre-apical white band. The major difference between the two subspecies is in the incidence of the two aberrant morphs, *dorippus* Klug and *alcippus* Cr., these are very rare in India but, in some areas, the prevalent forms in Africa, *alcippoides* Moore is a form with less white on the hindwing than *alcippus*. The form *albinus* Lanz, an insect with *dorippus* type of forewing and an *alcippus* hindwing, does not appear to occur in India but is not too uncommon in East Africa. Minor forms are *transiens* Suff., a *dorippus*-like form with the underside of the forewing, and sometimes the upper, with a subapical row of four or five white spots, and *bowringi* Moore with a bigger or smaller white spot in area 2, originally named from Hong Kong. A very rare form, of which I was lucky enough to breed an example in Calcutta, is *amplifascia* Talbot, which has the white subapical band extended inwards to the end of the cell, according to Talbot, only five specimens of this form have been recorded. Broadly speaking, only the *chrysippus* form is found north and south of the tropical zone. In the tropical zone itself, *dorippus* the prevalent form in the east with an admixture of *chrysippus*, *alcippus* and, more rarely, *albinus*, further west *dorippus* becomes

scarcer and finally on the West Coast *alcippus* is the only form.

Outside our limits, the species occurs all over Africa south of the Atlas Mountains, in Arabia and thence throughout tropical Asia to Australia. It is also found in the Canary Islands. The Australian subspecies is ssp. *petilia* Stoll.

f. *dorippus* is dominant to nomino-typical *chrysippus* in East Africa (Sevastopulo, 1976, *Entomologist's Record*, 89: 335). On the other hand f. *alcippus* appears to be recessive; a brood reared from a nomino-typical female produced four f. *chrysippus*, three f. *dorippus*, one f. *alcippus* and three f. *albinus*, no males appeared in this brood (Sevastopulo, 1976, *Entomologist's Record*, 88: 72). It would be interesting to investigate the genetics of Indian *dorippus* and *alcippus*. The species is easy to rear in captivity; females lay freely and, if the leaves provided for laying and feeding are stripped of the underside tomentum to remove tachinid ova, casualties are minimal.

D. chrysippus is the centre of a considerable mimetic complex in both India and Africa. In India *Danaus genutia* Cr. and *D. melanippus* Gray might be considered as not very good Mullerian mimics. The principal Batesian mimics are the females of *Hypolimnna misippus* L. (very good), *Argyreus hyperbius* L. (less good) (Nymphalidae) and *Elymnias hypermnestra* L. (not good) (Satyridae). I know of no day flying moths that mimic *chrysippus* in India. The African complex is much larger and includes the female forms *trophonius* Westw. and *trophonissa* Auriv. of *Papilio dardanus* Brown (Papilionidae), the same two Nymphalid females as in India, also the females of several species of *Euriphene*, *Bebearia*, *Euphaedra* and *Charaxes*, and of *Euptera crowleyi* Kirby, *Aterica galene* Brown f. *theophane* Hpffr. and of both sexes of *Pseudacraea deludens* Neave, which also mimics f. *dorippus*.

Among the Lycaenidae, both sexes of several species of *Liptenara*, *Telipna* and *Mimacraea* are *chrysippus* mimics. All the proceeding are Batesian mimics. *Acraea encedon* L., and a few other *Acraea* spp. are Mullerian mimics, as are presumably the following day flying moths, viz. *Heracilia poggei* Dew. (female only) (Agaristidae) and *Aletis helcita* L., *A. erici* Kirby and *Cartaletis libyssa* Hpffr. (Geometridae). *H. misippus* mimics all three principal forms of the model, as does *A. encedon*, whilst *Mimacraea marshalli* f. *dohertyi* Roths. mimics f. *dorippus*, otherwise f. *chrysippus* is the only model.

D. chrysippus is considered a well-protected species, due to the presence of cardenolides derived from the larval food-plants, but there is a considerable difference in the cardenolide content of the various food-plants and in the storage capacity of the various morphs. f. *alcippus* from the West Coast contains little or no cardenolides, and it is perhaps significant that its only Batesian mimic is the *alcippioides* form of *Hypolimnna misippus*, and that not a very good one. Birds eating *chrysippus* containing cardenolides react by vomiting.

Males of *D. chrysippus*, as all male Danaids, have to ingest pyrrolizidine alkaloids, usually from fermenting *Heliotropium* and *Crotalaria* spp., in order to produce the sex pheromone, in the absence of which females refuse to mate. These alkaloids are also poisonous and undoubtedly add to the distastefulness afforded by the presence of cardenolides, and this may account for the protection of the relatively cardenolide-free *alcippus*.

Talbot [FAUNA OF BRITISH INDIA, *Butterflies*, vol. ii (2nd edit.)] has described the early stages, and I have published descriptions in this *Journal* 1938, 40: 396 and 1946, 45: 190, and have presented typescript descriptions and photo-

graphs of the early stages of ssp. *aegyptius* to the British Museum (Natural History).

The larva occasionally produces teratological aberrations. In Calcutta I bred a larva which had additional tentaculæ on the left side only on somites 3, 6 to 10 and 12 (Sevastopulo, 1946, *Entomologist*, 79: 90) and in Mombasa I had a brood in which four larvae had additional tentaculæ on the somites immediately posterior to those normally bearing them (Sevastopulo, 1974, *Entomologist's Record*, 86: 223). This brood tends to confirm the opinion of the late Dr. E. A. Cockayne, expressed in many of his papers, that some forms of teratological aberration, spiral segmentation for an example, have a genetical basis.

I have found that larvae reared indoors in poor light exhibit a broadening of the black transverse lines.

The female is often very careless when laying, I have found ova on coarse grass, a cultivated Hibiscus and iron fencing wire which were mixed up with a bush of *Calotropis*, and it is doubtful whether the newly hatched larvae would have had the strength to reach their proper food-plant.

The pupa may be green or pink, and there is said to be a wax-yellow form that I have never seen. The pupa is usually formed on the food-plant, when it is green, but there seems to be no direct connection between the colour of the pupa and the substrate on which it is formed (Sevastopulo, 1948, *Proc. R. ent. Soc. Lond.* (A), 23: 93). Two larvae from the same brood can pupate side by side and produce two green pupae, or two pink, or one green and one pink.

Food-plant: Asclepiadaceae of many species, including some of the cactus-like forms, but *Calotropis* spp. is preferred. Pinhey (1949, BUTTERFLIES OF RHODESIA) adds *Rosa* (Rosaceae) and *Antirrhinum* (Scrophulariaceae) the

former is almost certainly wrong and the latter a copying error for the Asclepiad *Pentarrhinum*.

Danaus limniace Cr.

Strictly speaking this species should not be included in this paper as *D. petiverana* Dbl. & Hew., previously considered a subspecies of *limniace*, has now been shown to be a true species. Indian examples of *limniace* belong to ssp. *leopardus* Btlr. and are somewhat variable. *D. petiverana* occurs from the Transvaal and Zimbabwe to Ethiopia and the Sudan in the north, to Angola and Ghana in the west. It is occasionally migratory. The nomino-typical subspecies of *D. limniace* was described from China and a number of subspecies have been described from Sri Lanka, the Nicobars and Andaman Islands, Burma to south China, Taiwan, Luzon, the Celebes and Sula Islands, Java, Malaysia and Indo-China.

Both species provide the model for a mimetic complex but, unlike *chrysippus*, the African complex, is much smaller than the Indian. In East Africa the only mimic appears to be *Graphium leonidas* F. and Dr. The Hon. Miriam Rothschild, in a personal communication, has suggested that this may be a Mullerian mimic as the larva feeds on Annonaceae ssp. In India it is the model, to a greater or lesser extent, for a number of *Danaus* species (Mullerian); its Batesian mimics include *Papilio clytia* f. *dissimilis* L., *Graphium macareus* Godt., *G. xenocles* Dbl. and *G. megarus* Westw. (Papilionidae), females of *Valeria valeria hippia* F. (Pieridae), and the Nymphalids *Penthema lisardia* Dbl. and *Parkestina persimilis* Westw. There is another very similar complex based on *Danaus sita* Koll. and the two probably gain some mutual advantage from the rough resemblance between them. Further east it is a member of a very extensive mimetic association.

Dr. A. F. Rosa used the resemblance between the yellow, *philomela* F. female form of *valeria* and *Danaus aspasia* F. as one of the grounds for his hypothesis that mimetic pairs need not be sympatric, but could occur at opposite ends of the range of some migratory insectivorous bird (1937, *Entomologist*, 70: 32). (For a resume of the pros and cons of the case, see Sevastopulo, 1948, *J. Bombay nat. Hist. Soc.*, 47: 559.)

Dr. Richmond Wheeler, in contradiction to Talbot, denies that there is any mimicry between the females of *Valeria* and Danaids (1944, *Entomologist's Record*, 56: 90 and 1945, 57: 45, and Sevastopulo, *ibid.*, 1945, 47: 22 and 47: 105).

The early stages of both species are very much alike, the larva having only two pairs of tentaculæ (*chrysippus* has three) and the pupa is always green ornamented with large golden spots. Talbot (*loc. cit.*) has described the early stages of *limniace*, and I have also described it (as ssp. *mutina* Fruhs.) in this *Journal* (1938, 40: 396 and 1945, 45: 190). My typescript description and photographs of the early stages of *petiverana* have been presented to the British Museum (Natural History).

Food-plant: Asclepiadaceae of various species.

SATYRIDAE

Melanitis leda L.

The Indian subspecies of this wide-spread species is *ismene* Cr., whilst the African is now *helena* Westw. (previously *africana* Fruhs.). The main difference between the two subspecies is the very much more extensive orange patch surrounding the forewing ocellus in the African subspecies. Both subspecies are extremely variable on the underside of the dry season form, but I am of the opinion that there are a number of forms, the very beautiful one with a

lavender-brown underside edged with dull orange for example, that occur in India but not in Africa. On the other hand, the difference between the two seasonal forms seems more clear cut in India than in Africa, whence I have a number of examples of the dry season form with quite noticeable ocelli on the underside. The dry season form in India is *ismene* Cr., the wet *determinata* Btlr., the African seasonal forms do not appear to have been named. The species flies at dusk and has often been attracted to artificial light.

Outside our limits, the species extends to Southern Japan, Korea, Southern China and the whole of the Indo-Australian region.

Talbot (loc. cit.) describes the early stages and gives a rather poor outline drawing. I have described the early stages of *ismene* in this *Journal* (1942, 43: 40). My typescript description and photographs of the early stages of *helena* (as *africana*) have been presented to the British Museum (Natural History). There are three forms of larval head capsule, probably genetically controlled.

Food-plant: Grasses and Cereals (Gramineae), it has often been reported as a pest of wheat and rice.

***Ypthima asterope* Klug**

The Indian subspecies of this rather uninteresting small butterfly is *mahratta* Moore, which applies to the wet season form; the dry season form is *alemola* Swinh. It is found all over India. The nomino-typical subspecies occurs all over the Ethiopion Region, where a number of varietal names have been applied to minor aberrations in the number of ocelli on the underside of the hindwing.

Outside our area the range extends to Arabia, Syria and China.

I have not bred the species in India, nor does Talbot give any description of the early

stages. My typescript descriptions and photographs of the East African early stages have been presented to the British Museum (Natural History).

Food-plant: Grasses generally (Gramineae).

NYMPHALIDAE

***Hypolimnas misippus* L.**

Whilst specimens from India and Africa both belong to the nomino-typical subspecies, there is a very great difference in the incidence of the various morphs in the two areas. In India, the varietal female form *inaria* Cr., mimicking *Danaus c. dorippus*, and *alcippoides* Btlr., mimicking *D. c. alcippus*, are described as very rare, whilst f. *dorippoides* Auriv., mimicking *D. c. albinus*, does not appear to occur at all, but in Africa all three are common. Whilst the *chrysippus/misippus* complex is sometimes described as a typical example of a model/mimic relationship, this is not altogether correct. There is no correspondence between the frequency or rarity of the various model and mimic morphs in the same area, as an example all four female forms of *misippus* occur on the West Coast but the only *chrysippus* found there is *alcippus*. Again there is considerable variation in the form *inaria* and *alcippoides* in the coloration of the fore-wing apex and the extent of white on the hind-wing respectively. Personally I do not consider this second objection of any real validity; if *Argyreus hyperbius* can be described as a *chrysippus* mimic, these minor variations have no real importance. It has often been stressed that it is the general impression that is important, not a meticulous duplication.

Fruhstorfer, in Seitz' INDO-AUSTRALIAN RHOPALOCERA, uses the name *diocippus* Cr. for the female form having nomino-typical *chrysippus* as its model, but this is usually considered the typical female form of *misippus*.

The genetical relationship between the various morphs does not seem to have been established with any finality.

Outside our area the range extends to Indonesia, Taiwan, China, Japan and Australia, and it has recently colonised the West Indies, South America and the southern United States.

Bingham (FAUNA OF BRITISH INDIA, *Butterflies*, i) gives a brief description of the early stages (Talbot does not cover the Nymphalidae). I did not breed the species in India and my photographs and typescript descriptions of the East African early stages have been presented to the British Museum (Natural History).

Food-plants: *Asystasia*, *Justicia*, *Barleria* spp. and other Acanthaceae, *Portulaca*, *Talima* (Portulacaceae), *Abutilon* (Malvaceae).

When larvae are reared on *Portulaca* spp. care should be taken to place an absorbent pad under the food, otherwise the larvae can quite easily drown themselves in the semi-liquid frass.

***Junonia orithya* L.**

Two subspecies occur in India, ssp. *swinhoei* Btlr., smaller and paler below, from India, Baluchistan and Sri Lanka, and ssp. *ocyale* Hbn., larger and darker below, from Sikkim to Burma. Both are very common. The East African subspecies is *madagascariensis* Guen. and I have not found it common. Generally speaking, it is smaller and paler in dry areas and larger and darker in wet. Another subspecies, *here* Lang, occurs in Arabia. Outside our area the range extends to China (the type locality), the Malayan subregion, Japan and Australia.

Bingham (loc. cit.) gives a brief description of the Indian early stages, and I have described the early stages of *ocyale* in this *Journal* (1941,

42: 748). I have not bred the species in East Africa.

Food-plants: *Hygrophilla* (Acanthaceae), *Englas scandens* (Labiatae) (this appears to be an unusual abbreviation for *Englerastum*), *Antirrhinum*, *Striga lutea* (Scrophulariaceae), and in Saudi Arabia Convolvulaceae.

It has been suggested that *Junonia lavinia* Cr., is only an American race of *orithya*.

***Junonia hierta* F.**

Like the preceding species, *hierta* has two subspecies in India. Nomino-typical *hierta*, smaller, from Sri Lanka, India and Baluchistan, and ssp. *magna* Evans, larger and brighter, from Sikkim to Burma and the Andaman Islands. The African subspecies is *cebrene* Trim., from the entire Afro-tropical Region except Madagascar, where it is replaced by ssp. *paris* Trim. Whilst in India *orithya* is considerably commoner than *hierta*, in Africa the reverse is the case and *hierta* outnumbers *orithya* very considerably.

Outside our limits, the species occurs in Arabia, Socotra, Southern China, Hainan, Hong Kong and the Mergui Peninsula.

Bingham (loc. cit.) gives a brief description of the Indian early stages and my photographs and typescript description of the early stages of *cebrene* have been presented to the British Museum (Natural History).

Food-plants: *Asystasia*, *Barleria*, *Justicia*, *Paulowilhelmia*, *Ruellia* spp. (Acanthaceae).

***Vanessa cardui* L.**

After several changes in the generic name of this butterfly over the last few years, D'Abrera, in his recent book BUTTERFLIES OF THE AFRO-TROPICAL REGION uses *Vanessa* F.

This cosmopolitan species occurs all over India and Africa, usually more common on higher ground than in the plains, probably be-

cause of temperature. Due to its migratory habits it has evolved no subspecies with the exception of ssp. *kershawi* McCoy, from Australia. There are numerous published accounts of migrations in all parts of the world; the only one that I have witnessed personally was in mid-Mediterranean in June 1948, when a number of specimens flew on board the steamer on which I was travelling (1948, *Entomologist*, 81: 186).

Bingham (loc. cit.) gives a brief description of the Indian early stages and I have described them in 1941, in this *Journal* 42: 749. My photographs and typescript description of East African early stages have been presented to the British Museum (Natural History).

Food-plants: Anchusa, Cyanoglossum, Echiohim (Boraginaceae), *Arctium, Arctotis, Artemisia, Carduus, Chrysanthemum, Cirsium, Cynara filage, Gnaphalium, Heliochrysum, Lagera alata, Madia, Pentzia, Senecio, Sonchus, Stobaea* (Compositae), *Althaea, Malva* (Malvaceae), *Argyrolobium, Dolichos, Glycine, Lablab niger, Lupinus, Phaseolus* (Papilionaceae), *Boehmeria, Girardina, Laportea, Urtica* (Urticaceae) and, probably, many others.

Byblia ilithyia Drury

This species, that occurs all over Africa and in Southern and Central India and Sri Lanka, has not developed subspecies. Seasonal variation is very marked and the Indian dry season form has been named *simplex* Btlr. There is also considerable individual variation, but only African varieties appear to have been named.

Bingham does not give any description of the early stages and I have not bred the species in India. but there is a brief description in Seitz' INDO-AUSTRALIAN RHOPALOCERA. My typescript description and photographs of the East African early stages have been presented to the British Museum (Natural History). The

early stages of the Eurytelinae are all very much alike and some species are extremely difficult to separate.

Food-plant: Tragia and Dalechampia spp. (Euphorbiaceae).

The species does not occur outside our limits.

Argyreus hyperbius L.

Strictly speaking, the present species lies outside the range of this paper, but, as it is the only species common to Africa and India and absent from East Africa proper, I have included it.

The African subspecies, *neumanni* Roths. & Jord., is confined to forest margins above 2,100 metres in Ethiopia, and is tawny, not olivaceous, below. Two subspecies occur in India, nomino-typical *hyperbius* in the outer ranges of the Himalayas from Cambellpur in the Punjab to Sikkim, Uttar Pradesh, Madhya Pradesh, Manbhum in Bengal, Assam, the Khasi Hills and Upper Burma, and ssp. *castetsi* Ob. in Southern India. Ssp. *taprobana* Moore occurs in Sri Lanka. Ssp. *castetsi* differs from the others in not having a mimetic female, but a race, *hybrida* Evans, from the Nilgiris has both a mimetic and a non-mimetic female. Outside our limits the species extends to China, Taiwan, Sumatra, Java, Japan and Australia.

Bingham (loc. cit.) describes the Indian early stages and I have published a description in this *Journal* 1941, 42: 751.

Food-plant: Viola spp. (Violaceae).

Some authors ascribe the specific name to Johannes.

Phalanta phalantha Drury

The nomino-typical subspecies occurs throughout Continental India, Assam, Burma, Tenasserim and Sri Lanka, extending to China, Japan and the Malayan Subregion, it also reaches northern Australia at Darwin (ssp.

araca W. & L.), where it is rare. The African subspecies is *aethiopica* Roths. & Jord. and is found throughout the Afro-tropical Region, including Madagascar, the Seychelles, Aldabra, Comoro and Mascarene Islands, but is absent from south-western Cape Province. Ssp. *granti* Roths. & Jord. is confined to Socotra. Two of what were previously considered to be subspecies of *phalantha* have recently been raised to full specific ranks, these are *P. madagascariensis* Mab. from Madagascar and *P. philiberti* Joannis from Mahe, Praslin and Silhouette Is. in the Seychelles and is thought to be nearing extinction as it has not been collected since 1953.

Bingham (loc. cit.) gives a description of the Indian early stages and I have published descriptions in this *Journal* 1940, 42: 40 and 1947, 46: 577. I have not bred the species in East Africa.

Food-plants: Gymnosporia, Maytenus ovatus (Celastraceae), *Aberia, Dovyalis, Flacourtia* (Flacourtiaceae), *Trimeria* (Samydaceae), *Populus, Salix* (Salicaceae).

LYCAENIDAE

Apharitis acamas Klug

Strictly speaking this species falls outside our terms of reference as the African subspecies — *bellatrix* Btlr. — occurs in the Sudan, Somali Republic and south western Arabia. Two subspecies occur in India, ssp. *hypargyrus* Btlr. from Cutch, Sind, Punjab and Baluchistan, and ssp. *chitralensis* Riley from Chitral, where it is said to be not rare. Outside our limits it occurs in the Palaearctic Region and Algiers. I have not come across the species in either India or Africa. Nothing seems to be recorded about the early stages, but Peile (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA) writes 'In early August the abdomen of almost every female is

so distended with eggs as to look like a little ball, Colour of egg white.'

Lycaena phlaeas L.

Three subspecies of *phlaeas* occur in India, ssp. *stygianus* Btlr. from Baluchistan to Chitral and Ladak, *indicus* Evans in the Outer Himalayas, Kashmir to Kumaon, and ssp. *flavens* Ford in the Interior Himalayas to Sikkim. There are three subspecies in Africa, ssp. *abbotti* Holl., occurring in open situations at moderate elevations in Malawi, Tanzania and Kenya, ssp. *aethiopica* Poulton in Alpine areas in the Ruwenzori Mountains and *pseudophlaeas* Lucas in the highlands of Ethiopia. It has been suggested that *abbotti* represents an earlier migration and has separated far enough from the other two subspecies to be considered a good species. Outside our area it occurs throughout Europe, through temperate Asia to Japan and in the eastern states of America.

There appear to be no descriptions of the early stages of the Indian and African subspecies.

Food-plant: Rumex spp. (Polygonaceae).

Lampides boeticus L.

This almost cosmopolitan species occur all over India and Africa, where it is common, it is rare in the Andamans and Nicobars. It ranges all over the warmer parts of the Old World, reaching Australia, but it does not occur in America. Throughout its vast range it has not formed any subspecies, due to its migratory habits. Some years ago, a correspondent in the United States asked me for living material for experimental purposes, but was refused an import permit, possibly the Authorities were afraid of it becoming a pest.

Bingham (FAUNA OF BRITISH INDIA, *Butterflies*, Vol. ii) describes the early stages and I have published a description in this *Journal*

1938, 40: 399. My photographs and typescript description of East African early stages have been presented to the British Museum (Natural History).

Food-plant: *Cajanus cajan*, *Canavalia*, *Colutea*, *Crotalaria*, *Indigofera*, *Lathyrus*, *Lupinus*, *Medicago*, *Phaseolus*, *Pisum*, *Podalyria*, *Sesbania*, *Sutherlandia*, *Virgilia* (Papilionaceae), and probably many others. Feeding on the flowers and on unripe seeds in the green pods.

Leptotes pirithous L.

Upto fairly recently the species common to India and East Africa was known as *L. plinius* F., but a review of this very difficult genus has shown that it does not occur in Africa. However, one of the most common components of the complex, *L. pirithous* L., does occur in both Africa and India, as well as in the coastal regions of southern Europe, including all the larger Mediterranean Islands, northward to the southern Alpine slopes and over much of Asia. African species with which it can be confused are *L. babaulti* Stempf. (most of sub-Saharan Africa), *L. brevicaudatus* Tite (most of sub-Saharan Africa), *L. jeanneli* Stempf. (all sub-Saharan Africa) and *L. marginalis* Auriv. (Kenya, Uganda and Sudan). Superficially these species are almost impossible to separate and can only be properly identified by the genitalia. Both *pirithous* and *plinius* occur in India but I do not know whether they are allopatric or sympatric, nor whether any other members of the genus occur in India. A subspecies of *plinius* (?) — *pseudocassius* Murray — occurs in Australia.

Bingham (loc. cit.) gives a brief description of the early stages in India, and my typescript descriptions and photographs of East African early stages have been presented to the British Museum (Natural History) (both as *plinius*).

Food-plant: The varied nature of the food-plant records indicate the confusion in the genus. My own larvae, Bingham's record and the food-plant of *pseudocassius* are *Plumbago* sp. (Plumbaginaceae). Other records are *Burkea*, *Crotalaria*, *Indigofera*, *Medicago*, *Melilotus*, *Mundulea*, *Phaseolus*, *Pisum*, *Sesbania* (Papilionaceae). Higgins & Riley (A FIELD GUIDE TO THE BUTTERFLIES OF BRITAIN AND EUROPE), under *pirithous*, give 'small Leguminosae, broom, etc.' Which food-plant belongs to which species in the complex is unclear.

Zizeeria lysimon Hbn.

Some eyebrows may be raised at my inclusion of *Z. lysimon* Hbn. in the present paper, seeing that *Z. knysna* Trim. has been recognised as the correct name for the African population of this composite species for quite a considerable number of years. *Z. knysna* is found over the whole African continent, as well as in Madagascar and the Seychelles, *lysimon* in Southern Europe and in Central and Western Asia, within the Indian zone it occurs in Peninsular India south of the Outer Himalayan Range, Sri Lanka, Burma, Assam, Tenasserim, the Nicobars, and extending through the Malayan subregion to Australia. There seems to be a fairly general difference of opinion over the names of this species. Peile (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA) uses the name *karsandra* Moore, and states that Chapman considers *lysimon* to be African and *karsandra* Asiatic; Common (BUTTERFLIES OF AUSTRALIA) refers to *Z. knysna karsandra*, whilst Bingham states that *karsandra* is a pale aberration of *lysimon*. Seitz, in both INDO-AUSTRALIAN and AFRICAN RHOPALOCERA uses *lysimon*, whilst Evans (IDENTIFICATION OF INDIAN BUTTERFLIES) uses *lysimon*.

Bingham (loc. cit.) gives a brief description

of the Indian early stages and my typescript description and photographs of the East African have been presented to the British Museum (Natural History).

Food-plants: Amaranthus (Amaranthaceae), *Euphorbia* (Euphorbiaceae), *Oxalis* (Oxalidaceae), *Medicago*, *Zornia* (Papilionaceae), *Tribulus* (Zygophyllaceae).

Zizula hylax F.

This species, previously known as *gaika* Trim., occurs throughout Peninsular India, Sri Lanka, Assam, Burma, Tenasserim and the Andamans, and throughout the African continent and Madagascar. Outside our area it occurs in the Malayan Subregion to Sumatra and Java. The Australian subspecies is *attenuata* Lucas. Common (BUTTERFLIES OF AUSTRALIA) gives the distribution as 'throughout world equatorial belt' but in America it is replaced by *Z. cyna* Edwards, with which it has been confused. It seems strange that such small, feeble fliers as this species and the preceding should have such a wide distribution.

The species has a habit of swaying from side to side for a few minutes after alighting.

Pinhey (BUTTERFLIES OF RHODESIA) gives a brief description of the early stages and quotes Murray as saying that the ova are not flattened. I have not bred the species in either India or East Africa.

Food-plant: Oxalis spp. (Oxalidaceae), feeding on the flowers.

Azanus ubaldus Cr.

There seems to be some argument over who named this species. Most books cite Cramer as the authority, but d'Abrera cites Stoll as the author.

A butterfly of arid areas, it is found all over India, Burma and Sri Lanka. In Africa it is found in suitable areas from South to East

Africa, Somali Republic, across to Senegal and north to Tunisia. It is also found in Tunisia.

I have not bred the species in either India or East Africa, but Piele (A GUIDE TO COLLECTING BUTTERFLIES OF INDIA) states that the larvae are attended by ants and that the pupa is formed in ants' nests.

Food-plant: Acacia spp. (Mimosaceae).

Azanus jesus Guerin

Another dry country species, the nominotypical subspecies occurs throughout Africa. In India it is represented by ssp. *gamra* Led. occurring all over India, Burma and Sri Lanka.

The only description of the larva that I can find is in Pinhey (BUTTERFLIES OF RHODESIA) but he does not say whether it is attended by ants or not. I have not bred the species in either India or East Africa.

Food-plants: Acacia spp. (Mimosaceae), *Medicago* (Papilionaceae).

Freyeria trochilus Freyer

Two subspecies occur in India, nominotypical ssp. *trochilus* from north west India and ssp. *putli* Koll. from south to north-east India, Burma and Sri Lanka. Nominotypical *trochilus* occurs all over Africa. Outside our limits it occurs in south-eastern Europe, Arabia, Central Asia and through the Malayan subregion to Australia (ssp. *putli*).

The larva, which is attended by ants, has been described briefly by Bingham (loc. cit.) and I have published a description in this *Journal* 1941, 42: 284. I have not bred it in East Africa.

Food-plants: Heliotropium spp. (Boraginaceae), *Indigofera* (Papilionaceae).

HESPERIIDAE

D'Abrera does not include this family in his BUTTERFLIES OF THE AFRO-TROPICAL REGION,

considering the GRYPOCERA as being of equal status to the RHOPALOCERA and HETEROCERA. In consequence my typed descriptions and photographs of the East African Skippers were not taken to the British Museum (Natural History) by him along with those of East African Butterflies and remain in my possession for the present. I am, therefore, including short descriptions in this paper.

Gomalia elma Trim.

Upto fairly recently the nomino-typical African *elma* and the Indian *litoralis* Swinh. (from Sind and Baluchistan) and *albofasciata* Moore (from Sri Lanka and Southern India to Poona and Kangra) were all considered conspecific. Evans (A CATALOGUE OF THE AFRICAN HESPERIIDAE), however, now states that the genitalia of African *elma* and Indian *albofasciata* differ, implying that they are separate species, but makes no mention of *litoralis* which, presumably, remains a subspecies of *elma*. Outside our limits, the species occurs in Aden and Arabia. I did not meet the species in India, where it is said to be rare. In Africa it is common.

The glaucous green larva has a densely pubescent black head. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some later date.

Food-plant: Abutilon sp. (Malvaceae).

Spialia zebra Btlr.

In Africa, where it is fairly common, this occurs as ssp. *bifida* Higgins. The nomino-typical subspecies occurs in the Western Punjab, where it is said to be rare. Evans (loc. cit.) states that the genitalia of the two subspecies differ slightly. *S. z. bifida* occurs in Kenya and the Southern Sudan.

The yellowish green larva has a black head

densely clothed with erect black and whitish setae, forming a round black spot on each cheek and a posterior black band. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some future date. I did not breed the species in India.

Food-plant: Melhamia sp. (Sterculiaceae).

Pelopidas mathias F.

The nomino-typical subspecies occurs all over the Ethiopian Region, Madagascar, the Comoro Islands and Arabia, as well as in India, Burma, Sri Lanka, the Andamans, China, Japan, Taiwan, Malaysia, the Philippines and Celebes.

The blue-green larva has a fine white subdorsal line and the head has a white-edged black or dark red stripe on each cheek. I have typescript descriptions and photographs, which will be presented to the British Museum (Natural History) at some later date. I did not breed the species in India.

Food-plant: Grasses generally (Gramineae).

Pelopidas thrax Hbn.

Formerly considered a subspecies of *mathias*. Occurs all over Africa as ssp. *inconspicua* Bertolini. Nomino-typical *thrax*, which does not occur in the Ethiopian Region, is found in Egypt, Turkey, Cyprus, Syria, Arabia, Aden, Mesopotamia and in India (Cutch, Sind and Southern Punjab).

I have not bred the species in either India or East Africa.

Food-plant: Grasses generally (Gramineae).

Gegenes pumilio Loff.

The nomino-typical subspecies is found in N.W. India, i.e. Baluchistan, Chitral, the Khyber, and the Himalaya foothills to Mussoorie, as well as in Southern Europe, Cyprus, Syria

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and Mesopotamia. It has been confused with *G. nostrodanus* F., which does not occur in the Ethiopian Region. The African subspecies is *gambica* Mab. occurring over most of the Ethiopian Region.

The grass green larva has a triple dorsal, a double subdorsal and a double lateral darker

line. The head is pale green with a white-edged pink stripe on each cheek. I have type-script descriptions and photographs, which will be presented to the British Museum (Natural History) at some later date. I did not breed the species in India.

Food-plant: Grasses generally (Gramineae).